

Nitrogen Fixation on Early Mars and Other Terrestrial Planets. Experimental Demonstration of Abiotic Fixation Reactions to Nitrite & Nitrate.

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The abiotic fixation of nitrogen on early terrestrial planets, such as Mars and the Earth, is important for number of reasons. Nitrogen is an essential biochemical element and the prebiotic fixation of nitrogen into a form suitable for the formation of nitrogen containing prebiotic organic compounds is important for the origin of life. Since loss of nitrogen can result in loss of atmospheric pressure (and thus loss of the ability to sustain liquid water on the surface, the ability of the atmosphere to shield against radiation, loss of greenhouse effects, etc.), nitrogen fixation can have a profound impact on planetary habitability. Also, if nitrogen fixation processes depend on the presence of liquid water, the presence or absence of fixation products can be a marker for such water.

Current theories suggest the nitrogen can be fixed by a series of photochemical and thermal reactions, in the gas phase and in liquid water, to convert the products of shock heating (NO and CO) into nitrite and nitrate. However, except for the formation of NO by shock heating, this process is theoretical. Our work is experimentally verifying those theories and testing how planetary conditions, esp the presence of water, would affect nitrogen fixation. We will present results that show that fixation does indeed occur to produce nitrite and nitrate. The effect of water on the process will be examined and evidence for mechanisms proceeding through both HNO and NO₂ will be presented.